REMARKS

With the above amendments, claims 1-7, 9-11, 13-16, 18-23, and 27 remain in the application. Claims 12, 24, 25, and 26 have been canceled in this response without prejudice. Claim 27 has been added in this response.

Amendments to the Specification

The specification has been amended to indicate the patent number of a commonly-assigned application that has been incorporated by reference in its entirety.

Amendments to the Claims

Claims 1 and 13 have been amended to include an aspect of the invention relating to the use of a transport mechanism, which is fully disclosed on page 6, lines 5-19 of the specification, and schematically with an arrow on FIGS. 3A and 3B. It is respectfully submitted that FIGS. 3A and 3B along with the disclosure fully show this feature of the invention. Such a transport mechanism (e.g., a single or two axis stage; page 6, line 9 of the Specification) further shows the suitability of embodiments of the invention for use in an IC production environment. For example, such a transport mechanism further allows for a fully integrated deposition and calibration process (Specification, page 7, lines 13-21).

Claim 16 has been amended to include an aspect of the invention relating to calibration of multiple nozzles to dispense substantially the same amount (e.g., drop mass or volume) of material. This aspect of the invention is fully disclosed on page 6, lines 9-19 and page 7, lines 9-12 of the specification. The aspect of the invention recited in claim 16 advantageously allows for substantially uniform film thickness despite using several nozzles of varying characteristics.

It is respectfully submitted that the aforementioned aspects of the present invention are not disclosed or suggested in the references of record, either alone or in combination.

Claim Rejections 35 U.S.C. § 112

Claims 1-7, 9-16, and 18-26 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The rejection is respectfully traversed.

In regard to claim 1, the term "equipment" is recited as "integrated circuit manufacturing equipment." It is respectfully submitted that the structure and operation of an IC manufacturing equipment is disclosed throughout the specification (e.g., page 3, line 15 to page 4, line17; page 5, line 22 to page 7, line 21); in the incorporated U.S. application, which is now U.S. Patent No. 6,436,843; and schematically on FIGS. 1, 3A, and 3B. Claim 1 recites components in an IC manufacturing equipment.

In regard to claims 13, 16, 21, and 24, the term "equipment" is recited as an "integrated circuit manufacturing equipment," and is fully disclosed as discussed in regard to claim 1 above. As an example, in regard to claim 13, the "dispensing means" may be a print head with nozzles (FIG. 3A, print head 120), the "sensor means" may be sensing plates (FIG. 5, sensor 410), the circuit means may be the circuitry shown in FIG. 5, and the transport means may be a single-axis or two-axis stage (schematically depicted with an arrow on FIGS. 3A and 3B; discussed in the Specification on page 6, lines 7-9).

In regard to claim 16 and the term "calibrating," the calibration of nozzles in accordance with an embodiment of the present invention is fully disclosed on page 6, lines 9-19 and page 7, lines 9-12 of the specification. Claim 16 has also been amended to recite comparison of detected amount with a known good amount to include additional actions relating to calibration.

Still in regard to claim 16, the term "material" does not have to be the same as the first droplet because calibration may be performed separately from the deposition process. That is, deposition of material does not typically occur until after the calibration of the nozzles. Therefore, the recited "droplet" does not have to be the same as the recited "material."

In regard to claim 21, it is respectfully submitted that "a mechanism that dispensed the material" (i.e., "a control system configured to generate a tuning signal based on the output signal, the tuning signal being provided to a mechanism that dispensed the material") is recited before "the mechanism that dispensed the material" (i.e., "an integrated circuit manufacturing equipment, the integrated circuit manufacturing equipment being configured to employ the mechanism that dispensed the material to perform deposition on a wafer."). Therefore, the term "mechanism" has proper antecedent basis.

Claim 21 further recites a "control system" (e.g., see control system 101 on FIGS. 3A and 3B of the Specification) that generates a tuning signal that is provided to the mechanism that dispensed the material. Of course, a wafer is placed in the integrated circuit manufacturing equipment, and the integrated circuit manufacturing equipment may employ the mechanism for deposition of material on a wafer (by controlling flow of material thereon, for example).

Claim Rejections 35 U.S.C. § 102

Claims 13 and 14 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,617,079 to Pillion et al ("Pillion"). To anticipate a claim, a reference must disclose all the elements of the claim.

Claim 13 is patentable over Pillion at least for reciting: "the dispensing means including a plurality of nozzles" and "transport means for moving the dispensing means from a position over a wafer to a position over the sensor means." Pillion discloses a relatively complicated sensor that includes an energy source that detects the profile of a liquid. Pillion's system is over the wafer and adjusts the drop of the nozzle during wafer deposition (Pillion, 3:10-42). Furthermore, Pillion specifically teaches away from the use of multiple nozzles because, according to Pillion:

> "A satisfactory fluid dispense is one which is formed from a single discrete volume of fluid rather than a plurality of discrete volumes of fluid. When a plurality of discrete fluid volumes are dispensed, the resultant coating on the substrate is characterized by a more variable thickness or striations as compared

> to the uniform coating generated with a single discrete fluid volume. Accordingly..."
>
> (Pillion, 4:19-25)

This is the reason why even when multiple energy detectors are employed, Pillion teaches using all of the detectors along the travel path of the same fluid dispense nozzle (Pillion, 4:39-48). Pillion does not have a need to calibrate multiple nozzles so that the nozzles dispense substantially same amounts of material, and therefore does not disclose or suggest multiple nozzles nor transportation of a dispensing mechanism with multiple nozzles between a calibration position and over a wafer. In Pillion, the energy detectors and the wafer are necessarily in-line. Therefore, it is respectfully submitted that claim 13 and dependent claim 14 are patentable over Pillion.

Claim Rejections 35 U.S.C. § 103 – Pillion/Carmichael Combination

Claim 15 stands rejected under 35 U. S. C. section 103 (a) as being and patentable over Pillion and in view of U.S. Patent No. 3,852,768 to Carmichael at el. ("Carmichael"). As discussed above in regard to claim 13, Pillion does not disclose or suggest a dispensing means having a plurality of nozzles and a transport means for moving the dispensing means from a position over a wafer to a position over the sensor means. Neither does Carmichael. For example, Carmichael does not disclose the recited transport means, while Pillion teaches away from the use of several nozzles in a wafer deposition process.

Moreover, it is not clear how the sensor taught in Carmichael may be employed in the system of Pillion to render claim 15 obvious. Carmichael and Pillion teach two different sensor configurations – one cannot be replaced with the other without completely changing its operation. For example, Carmichael uses plates to sense a droplet while Pillion uses an energy detector and profile analysis. It is not clear how the energy detector of Pillion can be modified to sense velocity. If Carmichael's sensor is employed in Pillion, Pillion's energy detector and profile analysis will no longer work, making it unsuitable for its intended purpose. It is also not clear why one of ordinary

skill in the art would add another sensor configuration to Pillion's system in addition to Pillion's energy detector. Pillion does not discuss or suggest adding velocity detection, or the need for such velocity detection.

It is also not clear how Carmichael's sensor would be incorporated in Pillion's system without affecting Pillion's energy detector. Such a combination would "shoe horn" Carmichael's sensor into Pillion's system, and appears to be hindsight reconstruction in view of the teachings of the present invention.

Therefore, it is respectfully submitted that the combination of Pillion and Carmichael fails to render claim 13 unpatentable. Claim 15 depends on claim 13. Therefore, it is respectfully submitted that claim 15 is patentable over the Pillion/Carmichael combination at least for the same reason that claim 13 is patentable, as well as because of the combination of features set forth in claim 15 and in claim 13.

Claim Rejections 35 U.S.C. § 103 – Nishimura/Carmichael/Osborne Combination

Claims 1-7, 9-16 and 18-26 stand rejected under 35 U. S. C. § 103 (a) as being anticipated by U.S. Patent No. 5,705,935 to Nishimura ("Nishimura") in view of U.S. Patent No. 4,922,268 to Osborne ("Osborne") and further in view of Carmichael. The rejection is respectfully traversed.

Claim 1 is patentable over the Nishimura/Carmichael/Osborne combination at least for reciting: "a print head having a plurality of nozzles" and "a transport mechanism configured to move the print head between a position over the wafer and another position over a sensor module, the sensor module being configured to receive droplets from the nozzles of the print head to allow the nozzles to be calibrated to dispense a substantially same amount of material."

As a preliminary matter, Nishimura's printhead 12f does not necessarily have to have a plurality of nozzles. For a feature to be inherently present in a disclosure, the disclosure must necessarily have the missing feature. Here, as evidenced by Pillion, a dispenser may only have a single nozzle to dispense a single volume of droplet. Furthermore, Nishimura is only concerned about printing mapping data on a die (see

Nishimura, 3:4-15), not deposition of a thin film on a wafer using the print head. Therefore, it is quite likely that Nishimura's printhead 12f has a single pen (i.e., a single "nozzle").

Moreover, Nishimura does not disclose or suggest the recited transport mechanism. Neither does Carmichael. Because Nishimura's application merely requires marking as opposed to deposition, Nishimura does not need, and accordingly does not disclose or suggest, features that would facilitate calibration of nozzles to dispense a substantially same amount of material. Osborne discloses a carriage for moving a print head over orifice plates 20 to determine inter pen offset in a paper application. Osborne is not concerned with depositing uniform amounts of material on a wafer, and therefore does not disclose a transport mechanism to move a print head over a sensor and over a wafer.

It is also not clear why one of ordinary skill in the art would be motivated to combine the teachings of Nishimura, Carmichael, and Osborne in a manner recited in claim 1. As mentioned, Nishimura merely places marks on the wafer for data management purposes. Carmichael discloses a sensor to sense velocity, deflection, and stream running. Osborne discloses calibration of inter pen offsets (i.e., position), not deposition amounts. None of these references discloses or suggests the need to dispense substantially uniform amount of droplets from a plurality of nozzles to obtain substantially uniform deposition on a wafer. Such a need is only disclosed in the present disclosure, not in Carmichael, Nishimura, or Osborne. It is respectfully submitted that to pick and choose components from Carmichael, Nishimura, and Osborne using the present disclosure as a blueprint constitutes impermissible hindsight reconstruction. This is especially true considering that Pillion teaches away from using multiple nozzles in a wafer deposition process in the first place.

Claims 2-7 and 9-11 depend on claim 1. Therefore, claims 2-7 and 9-11 are patentable over the Nishimura/Carmichael/Osborne combination at least for the same reasons that claim 1 is patentable, as well as because of the combination of features set forth in these claims and in claim 1. For example:

In regard to claim 2, none of the references of record discloses or suggests a sensor configuration including a bias voltage on a second plate. Note that Carmichael discloses a substantially different sensor circuitry wherein the sensor plate is grounded, not biased (see Carmichael, FIG. 2).

In regard to claim 3, none of the references of record discloses or suggests a sensor configuration including an input transistor between the amplifier and the first plate (e.g., see Specification, transistor 521 on FIG. 5). Note that Carmichael discloses a substantially different sensor circuitry without a transistor between the FET and the sensor (see Carmichael, FIG. 2).

In regard to claim 4, none of the references of record discloses or suggests sensing of drop mass using two plates. Pillion teaches sensing of volume. However, Pillion uses a totally different sensor from that recited in claim 1.

In regard to claim 7, none of the references of record discloses calibration of multiple nozzles to have substantially same drop mass.

In regard to claim 9, none of the references of record discloses providing the output signal to a signal processing device, let alone a computer as recited in claim 10. Pillion discloses the use of a computer for profile analysis. Pillion, however, does not disclose calibration of multiple nozzles and does not use sensors comprising plates. Pillion uses a relatively complicated energy detector.

Similar to claim 1, claim 13 is patentable over the Nishimura/Carmichael/Osborne combination at least for reciting: "dispensing means for dispensing a droplet in the integrated circuit manufacturing equipment, the dispensing means including a plurality of nozzles" and "transport means for moving the dispensing means from a position over a wafer to a position over the sensor means."

Claims 14 and 15 depend on claim 13. Therefore, claims 14 and 15 are patentable over the Nishimura/Carmichael/Osborne combination at least for the same reasons that claim 13 is patentable, as well as because of the combination of features set forth in these claims and in claim 13. For example:

In regard to claim 14, none of the references of record discloses or suggests sensing of drop mass using two plates (the structure disclosed in the Specification for the sensor means). Pillion teaches sensing of volume. However, Pillion uses a totally different sensor from that recited in claim 13.

Claim 16 is patentable over the Nishimura/Carmichael/Osborne combination at least for reciting: "detecting a presence of the first droplet; generating a first output signal indicative of a first amount of the droplet; comparing the amount of the first droplet to a known good amount; calibrating the first nozzle of the print head based on the comparison of the first amount to the known good amount." It is respectfully submitted that none of the references of record, together or in combination, discloses or suggests a calibration method for a first nozzle of a print head having a plurality of nozzles that involves a comparison of a detected amount (e.g., mass or volume) from the first nozzle with a known good amount.

Claims 18-20 and 27 depend on claim 16. Therefore, claims 18-20 and 27 are patentable over the Nishimura/Carmichael/Osborne combination at least for the same reasons that claim 16 is patentable, as well as because of the combination of features set forth in these claims and in claim 16.

Claim 21 is patentable over the Nishimura/Carmichael/Osborne combination at least for reciting: "a control system configured to generate a tuning signal based on the output signal, the tuning signal being provided to a mechanism that dispensed the material, the mechanism that dispensed the material including a plurality of nozzles; and an integrated circuit manufacturing equipment, the integrated circuit manufacturing equipment being configured to employ the mechanism that dispensed the material to perform deposition on a wafer" (emphasis added). The Nishimura/Carmichael/Osborne combination fails to disclose such a control system for a dispensing mechanism having a plurality of nozzles, where the dispensing mechanism is also employed for wafer deposition.

Claims 22-23 depend on claim 21. Therefore, claims 22-23 are patentable over the Nishimura/Carmichael/Osborne combination at least for the same reasons that claim

21 is patentable, as well as because of the combination of features set forth in these claims and in claim 21.

Conclusion

For at least the above reasons, it is respectfully submitted that claims 1-7, 9-11, 13-16, 18-23, and 27 are in condition for allowance. The Examiner is invited to telephone the undersigned at (408)436-2112 for any questions.

If for any reason an insufficient fee has been paid, the Commissioner is hereby authorized to charge the insufficiency to Deposit Account No. 50-2427.

Respectfully submitted,
Henner W. Meinhold et al.

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Patrick D. Benedicto, Reg. No. 40,909
Okamoto & Benedicto LLP
P.O. Box 641330
San Jose, CA 95164
Tel.: (408)436-2110
Fax.: (408)436-2114

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